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REPORT ON BROADCAST SLASH BURNING

IN SELECTIVELY CUT PONDEROSA PINE STAND

COLVILLE INDIAN RESERVATION - WASHINGTON

FALL OF 1943

by
Harold Weaver
Forest Supervisor

Paul Keen

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INTRODUCTION

Since Pearl Harbor the lumber operators on the Colville Indian Reservation, in common with the other units of this critical industry, have had extreme difficulty in maintaining sufficient man-power to produce the lumber needed for our armed forces and the war industries. Before it was rather belatedly recognized that the lumber industry is of vital importance in production for total war, the armed forces "skimmed the cream" of the available experienced man-power supply, through enlistments and inductions. Also, other higher paying war industries, such as the aircraft manufacturers and the shipyards, made serious inroads on the supply of woods and mill workers, even after the men were supposedly frozen to their jobs.

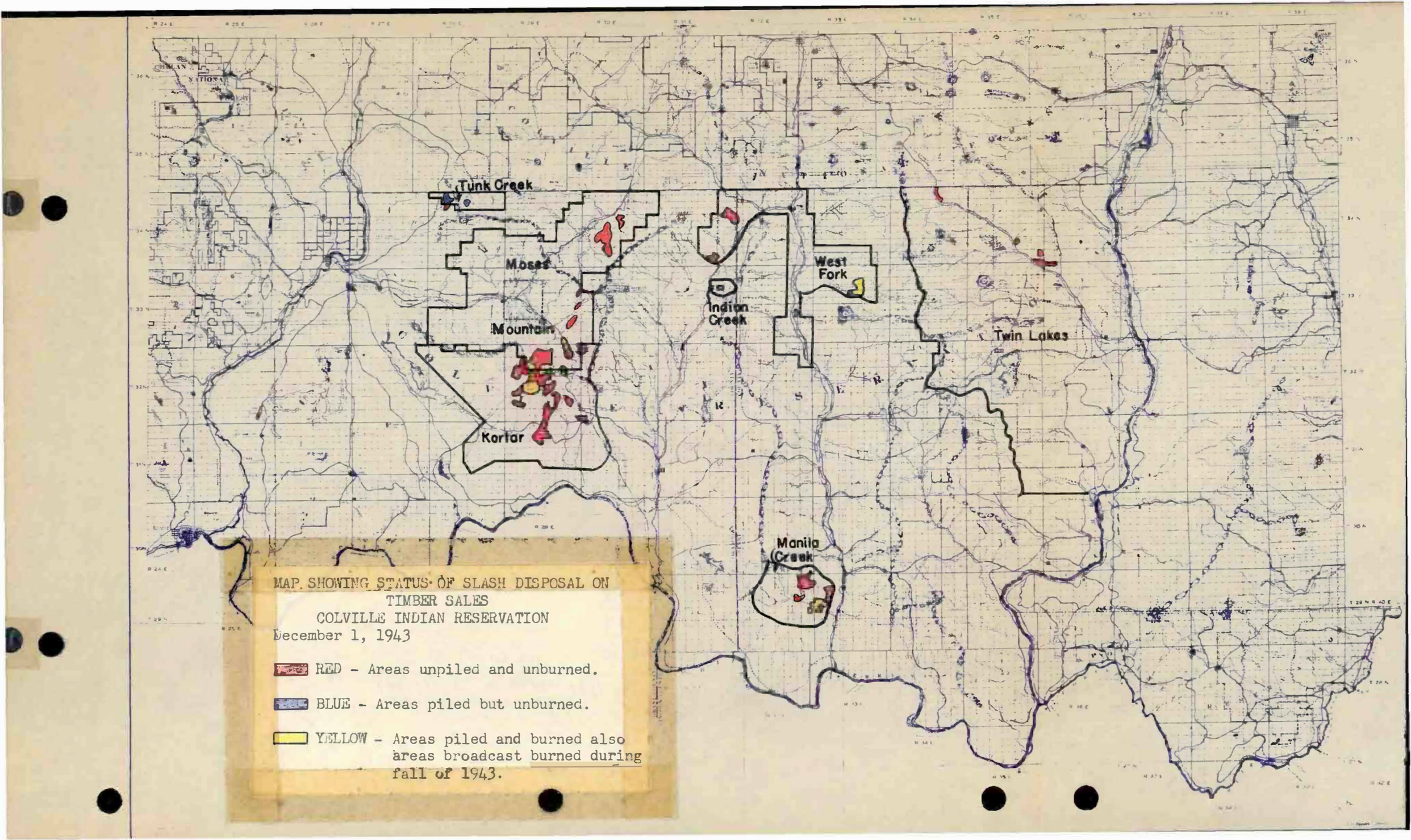
As a natural result of the man-power shortage in the woods, logging slash disposal operations, though required by the timber cutting contracts, have largely been neglected in favor of intensive efforts to produce sufficient logs to keep the mills operating on the war orders. In normal lines such a situation would not be tolerated and, if necessary, the operations would be closed down to insure that slash disposal be kept current with the cutting. Under present conditions, however, it has thus far been impossible to take such drastic measures for, even though the accumulating slash is causing a terrific fire hazard that endangers the forest, it has been considered unwise to interfere with production. Every able bodied man that the loggers can hire is needed for production while most of the other laborers who, with respect to age and physique, are not up to the minimum standards required for log production and transportation, but who would qualify for slash piling, are not interested in such work at any wage rate. Why should they work hard at "brush piling" when equivalent wages can be earned in other less strenuous industries?

As a result of this situation the operators on the Colville Reservation are approximately two years in arrears with respect to their contractual slash disposal operations. Table No. I and the map showing the status of slash disposal on timber sales, to the date of December 1, 1943, summarize this situation.

TABLE No. I

STATISTICAL SUMMARY OF COLVILLE RESERVATION SLASH DISPOSAL OPERATIONS FOR YEAR 1943, ALSO SUMMARY OF SITUATION OBTAINING DECEMBER 1, 1943

Name of Timber Unit	Slash Disposed of Fall 1943			Slash Unpiled & Unburned Dec. 1, 1943	
	No. Acres	Volume M. Ft. B.M.	Method Used	No. Acres	Volume M. Ft. B.M.
Moses Mt.	200	1,750	pile & burn	3,600	29,700
Kartar	(400	3,000	pile & burn		
	(720	4,500	broadcast burn	3,000	23,500
Tunk Creek				40	300
West Fork	340	3,000	Broad-cast Burn	1,450	8,000
Manila Creek	480	2,000	pile & burn	1,260	4,300
Indian Creek	20	200	pile & burn	20	200
Twin Lakes	160	600	pile & burn	560	2,800
TOTAL	2,320	15,050		9,930	68,800


Tunk Creek
Moses
Mountain
Korlor
Indian Creek
West Fork
Twin Lakes
Manila Creek
MAP SHOWING STATUS OF SLASH DISPOSAL ON
TIMBER SALES
COLVILLE INDIAN RESERVATION
December 1, 1943
RED - Areas unpiled and unburned.
BLUE - Areas piled but unburned.
YELLOW - Areas piled and burned also areas broadcast burned during fall of 1943.

No one knows how much longer the war will continue and the present shortage of man-power in the woods will persist. Optomists believe that Germany will be defeated sometime during the year of 1944, after which it can be expected that the man-power situation will be improved to a certain extent. In any event it appears probable, if the experience of the past two years is any indicator, that the total volume of unpiled and unburned slash on the Colville Reservation may eventually reach the 150,000,000 board foot mark and that it will lie strewn about over 22,000 to 25,000 acres. In the meantime accidental summer fires may radically alter the situation.

After the war ends and men can be hired for slash piling in the woods shall we insist on 100 per cent disposal of this huge volume of slash by the pile and burn method? When considering this question it should be remembered that the longer the slash lies on the ground the harder it will become to pile it compactly, in such manner that it can be disposed of during periods of low fire hazard. Most of the needles, after approximately one year, have a tendency to shatter and fall from the twigs when the swamper strikes the branch with his axe. After two years most of the needles fall by natural process and any attempt to handle the branches results in the loss of the remainder. Under such circumstances it becomes impossible to make satisfactory piles without the lavish use of pitchforks and rakes, which increases the cost of the operation tremendously. Therefore it will probably be impractical, because of the time element and the expense, to insist on 100 per cent disposal by piling and burning. Instead it will probably be necessary to accept partial disposal. Under such a method from 15 to 25 per cent of the slash can be piled along the old logging roads and favorable natural situations, such as ridge tops or streams, in such manner that effective fire breaks can be cleared.

What, then, should be the treatment to be applied to the "blocks" of unpiled slash? One school of thought favors leaving such slash unmolested, with intensified protection for the first few years of supposedly more critical fire hazard. Certainly the method recommends itself for areas where excellent stands of ponderosa pine seedlings are becoming established, The writer is doubtful, however, with respect to the lessening of the critical fire hazard after the first few years and the lessening of the need for intensified protection.

The method apparently works well in the Douglas fir type and, more particularly, in the coastal Sitka spruce - hemlock type of western Washington and western Oregon. There, on favorable situations, if fire can be kept out of the tremendous accumulation of slash for the first few years, the fire hazard actually does decrease progressively in intensity until at the end of approximately 15 to 20 years it again coincides with that of the un-cut, unmolested forest. It should be remembered, when accounting for this phenomena, that the Douglas fir and Sitka spruce - hemlock stands are largely characteristic of the mesophytic forest. There, because of the action of fungi encouraged by the heavy rainfall, the flash fuels, such as the needles, leaves and twigs rapidly disintegrate. Also, exceedingly dense stands of reproduction usually establish themselves within a few years

on such lands. Because of the heavy rainfall and the abundant soil moisture the growth of these stands is exceedingly rapid and competition between the trees is largely for top and side light. Within 15 to 20 years therefore the young trees usually have formed a closed canopy that almost completely shades the ground. Under such conditions the growth of moisture adapted, shade enduring ground plants of low fire hazard are encouraged and the old tops, cull logs and other heavy logging debris remain damp during most of the year, as do the windfalls and debris littering the floor of the virgin forest, and disintegration by the wood-rotting fungi is promoted. Only during prolonged droughts does the fire hazard become critical in such stands. Indeed when fires occur in slashings in the Sitka spruce-hemlock type the foresters and loggers speak of "running the fire into the green timber to stop it". Such an expression seems strange to men familiar only with the pine region.

In the ponderosa pine stands east of the Cascades, in sharp contrast, conditions are largely characteristic of the xerophytic forest. Due to the scanty rainfall the mature stands are light in volume and comparatively open. Growth in the immature stands is also slow in comparison to that of the coast Douglas fir and Sitka spruce. When overly dense reproduction stands become established poor growth or growth stagnation are the usual result, under average to poor site conditions. Even where such stands of almost completely closed canopy can develop the fuels of the forest floor readily become tinder dry and explosive during the long dry periods of summer. Decay and disintegration of snags, windfalls and other heavy debris resulting from logging is exceedingly slow and the needles and twigs, after they fall to the ground, remain resinous and readily become tinder dry for many years, perhaps decades, thereafter.

Before the advent of attempted total fire exclusion in the ponderosa pine region most of the ponderosa pine stands were swept periodically, at comparatively frequent intervals, by surface fires that consumed the dead materials of the forest floor, together with large portions of the material in dead snags and windfalls, and that thinned the reproduction patches developing in the openings. These fires have occurred down through the ages. Dr. Willis Linn Jepson, in discussing the role of fire in the forests of the Sierra Nevada Mountains of California, made the following statement "Indeed the main silvical features, that is density, reproduction power and dominance of types, are in great part expressions of the periodic fire status".

Because of the past role of fire in the ponderosa pine forest and because of the changes that have taken place on sizeable areas as the result of total fire exclusion, the writer is inclined to view the leaving of logging slash unmolested with what may be termed "the jaundiced eye". He believes that there is no such an applicable term as "decreasing fire hazard" for the average ponderosa pine stand, unless the hazard is actually removed. It is admitted that the present intensive use of these forests, required by our civilization, necessitates rigid control of fires. It is his opinion, however that far too little thought and study have been given to the possibility of utilizing controlled fire as a silvicultural tool, not only for the disposal of logging slash, but, in addition, for the lessening of the fire hazard on other areas, for the

thinning of overstocked reproduction stands of ponderosa pine and for the partial elimination of other less desirable and less fire resistant species, such as white fir and Douglas fir, that tend, under total fire exclusion, to capture ground formerly occupied by ponderosa pine.

In the ponderosa pine region it may be said, with respect to this problem, that "the hand writing is on the wall" and that the most rabid advocates of continued total fire exclusion will eventually be forced to read it. After excluding fires for from 30 to 40 years on many large areas we find that the hazard has increased to such a degree that control of fires is exceedingly difficult and any fire, once out of control, is apt to develop into a holocaust that destroys everything in its path. This has been demonstrated many times, on areas where in the early days crews consisting of six to twelve men used to put out fires thousands of acres in extent. One favorite method of building fire line on the Klamath Reservation in southern Oregon, in early days, used to be by dragging a bush or chunk behind a saddle horse. Now, for large fires of similar area on that reservation hundreds of men and every logging bulldozer that can be transported to the scene are usually needed before control is established.

What the final answer is the writer does not pretend to know. Certainly fire should not be used promiscuously, but only after thorough research has determined conditions under which it can be used to attain the result desired. It has previously been conceded in this paper that in the absence of piling and burning, slash should probably be permitted to lie unmolested on areas where excellent stands of ponderosa pine seedlings are becoming established. What of the future of such areas? Perhaps after the seedlings grow into poles of such height that the live crowns of the dominants and co-dominants will stand an excellent chance of escaping excessive scorching, the old slash and other debris can be disposed of by controlled burning. Experiments should certainly be undertaken to determine the feasibility of such operations.

A start in this direction was made on the Colville Reservation, during the fall of 1942, when five tracts of dense ponderosa pine reproduction, totaling 238 acres in area, were burned on an experimental basis. A detailed description of these operations has been given by the writer in "Preliminary Report on Controlled Burning Experiments, Colville Indian Reservation, October 1942". Other reports will be given on these operations as studies initiated thereon progress. At this early date it has been found, as expected, that most of the small ponderosa pine seedlings succumb to surface fires of even light intensity. After they develop into saplings, 10 to 15 feet in height and 2 to 3 inches in diameter, however, most of the dominants and co-dominants apparently have an excellent chance of surviving a surface fire of moderate intensity. Pole size trees, it has been found, can in many cases survive a terrific scorching.

The broadcast slash burn areas, described in the balance of this paper should also be given as intensive study as personnel and time will permit. These broadcast burning operations were undertaken in desperation, so to speak, in an attempt to break up the large slash areas in such manner that our small protective force will have some chance to control possible accidental summer fires resulting from lightning, human carelessness, or incendiarism. As is indicated in the follow-

ing descriptions, burning conditions for such operations were not always ideal (they seldom are). Lack of man-power also was a factor having important influence on the manner in which the burning was conducted. As is to be expected results, also, were not ideal, with respect to damage to reproduction stands and reserve stands. As a result of the experience gained on these operations, however, the writer definitely believes that broadcast burning can be profitably used under certain conditions to dispose of slash in selectively cut ponderosa pine stands.

Broadcast burning, it is true, has an ugly implication, because of its past misuse in the ponderosa pine region. The urgency of the slash situation on the Colville Reservation, however, and the experience above referred to, lead to the conclusion that it must be used even more extensively, at least for the duration of the war.

Table No. II, which follows, summarizes the available weather data for the period during which the broadcast burning operations were being conducted. Reference will be made to it in the pages following.

TABLE NO. II

SUMMARY OF WEATHER CONDITIONS PREVAILING AT COLVILLE AGENCY DURING THE PERIOD THAT BROADCAST SLASH BURNING OPERATIONS WERE BEING CONDUCTED ON THE COLVILLE INDIAN RESERVATION, WASHINGTON - FALL of 1943.

Date	Max. Temp.	Min. Temp.	Precip. Inches	Relative Humidity			Fuel Moisture			Wind Direction and Velocity			Days Since Rain
				8 AM	12 N	4:30 PM	8 AM	12 N	4:30 PM	8 AM	12 N	4:30PM	
Sept. 20*	82	53		65	35	18	8.4	7.2	5.8	C	W3	NW8	18
Sept. 21*	77	37		50	18	25	8.4	7.6	6.1	W2	W3	W2	19
Sept. 22*	82	40		52	27	24	8.3	6.8	6.2	NW3	NW5	SW4	20
Oct. 5*	72	47	.01	55	46	44	13.8	10.8	10.1	NW3	NE6	NE8	0
Oct. 6*	87	60		48	27	24	10.0	8.0	7.0	NE12	W6	C	1
Oct. 9*	76	51	.02	50	38	41	10.6	9.7	12.4	W3	W9	SW6	0
Oct. 10*	62	54	.08	77	68	62	30.6	31.4	33.3	C	C	SW7	0
Oct. 11			.07										0
Oct. 14*													

* Broadcast slash burning conducted during these days.

TWENTYTHREE MILE SLASH BURN

Location & Area

The map of this area attached hereto, includes approximately 388 acres in sections 10 and 15, township 33 north, range 33 east, W. M., in the basin of Twentythree Mile Creek in the West Fork Timber Unit. Actually, for reasons that will be explained, approximately 48 acres still remain to be burned at the earliest apportune time.

Topographic & Geologic Features

As the map indicates, the burn lies on gentle to moderate south slopes, ranging in elevation above sea level from 3,200 feet at the south end, in section 15, near Twentythree Mile Creek, to 3,900 feet at the north end, on the steepening slope in ~~section~~ section 10. A topographic feature of interest is the low butte in SW¼ SE¼ section 10. Another is the shallow draw, originating on the steeper slope north of the low butte then extending southeasterly until it leaves the burned area from NE¼ NE¼ section 15.

The greatest portion of the area appears to be underlaid by glacial drift, though moraine boulders are not conspicuous on the surface. The soil is a deep sandy loam, except where bare granite outcrops occur on the low butte and on the upper slope at the north end of the burn.

The Forest

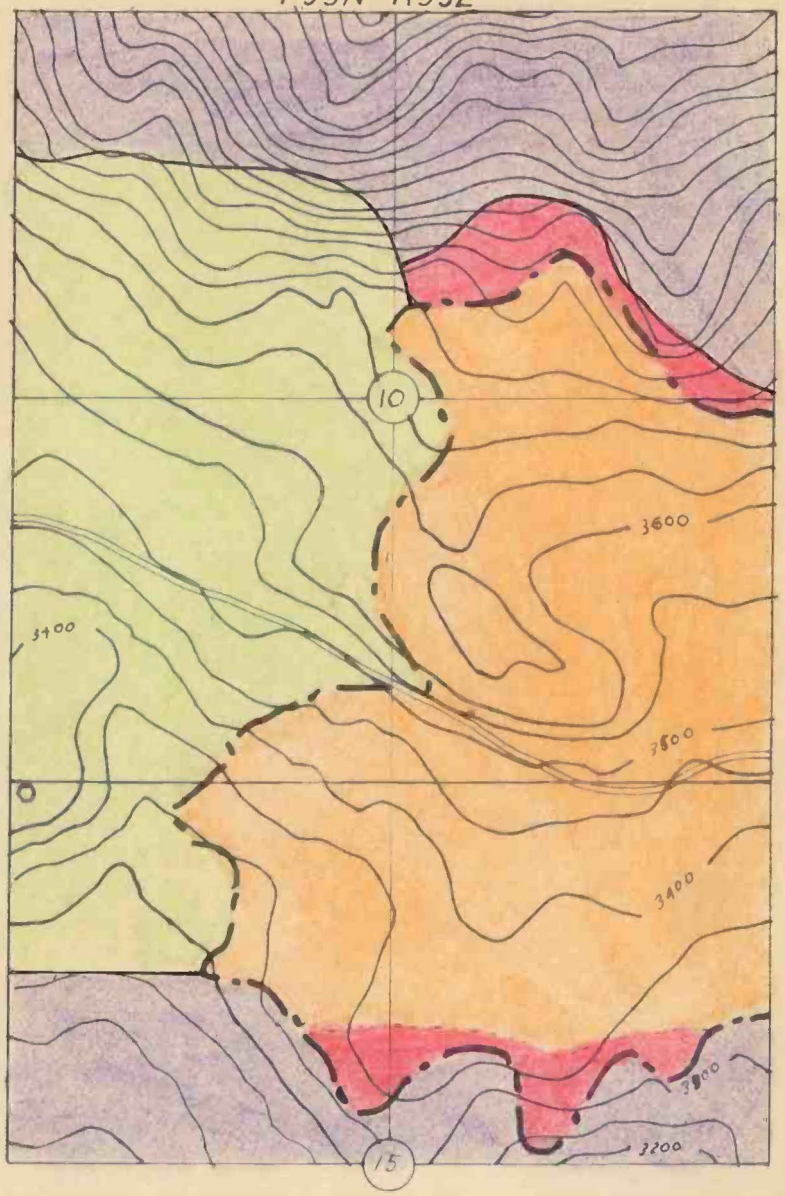
Before logging, this area together with the area adjoining to the west, where the logging slash has been disposed of by the pile and burn method, supported one of the heaviest and most uniform stands of ponderosa pine to be found on the Colville Reservation. In fact a large un-cut portion of this stand still remains along the east boundary of the burn, in sections 11 and 14. It is estimated that the virgin stand averaged 16 to 17 thousand board feet per acre in volume. Of this volume ponderosa pine comprised approximately 90 per cent and Douglas fir and western larch 10 per cent. The bulk of the stand was even aged, with most of the ponderosa pines appearing characteristic of younger mature trees of age class 3, in accordance with Keen's Ponderosa Pine Tree Classification. Many of the trees, however, though actually of the same age class, had the physiological characteristics of Keen's age class 2. This is true particularly of many of the trees now remaining in the reserve stand.

This condition, as can be appreciated by foresters familiar with such stands, presented quite an interesting problem in timber marking. Most of the trees, because of the comparatively crowded conditions, had crowns of classes C and B. The timber marker, Mr. Edward Hall, Scaler, therefore had to disregard many of the rules usually applicable to marking ponderosa pine on this reservation. He did an excellent job, as is attested by the present uniform reserve stand, comprising approximately 40 per cent of the original pine volume.

23 Mile Slash Burning

Burned Sept. 20-22, 1943

T33N R33E



Broadcast Burned
Slash Unpiled & Unburned
Slash Piled & Burned
Uncut Timber Dec 1943

Scale

0 1/4 1/2 mile

Contour Interval 50 Feet

Occasional large overmature trees of Keen's age class 4 were found on the low butte and on the steeper slopes at the upper end of the burn. They apparently were survivors of some catastrophe, possibly fire, or a combination of insect attack and fire, that destroyed the bulk of the stand some 200 years ago. Subsequently, as a result of the wholesale and almost total destruction of the older stand, there developed the even aged stand herein described. Numerous surface fires of moderate intensity subsequently swept the area, as is attested by the record of the fire scars that many of the trees bear. The last of such fires occured in 1926.

In general view the forest floor appeared open and comparatively free of debris, except for occasional patches of Douglas fir, ponderosa pine and lodgepole pine reproduction, occuring principally in openings caused in the overstory by the attacks of the western pine beetle, subsequent to the 1926 fire. Also, it should be mentioned, there were many standing larch and Douglas fir snags, probably caused by insect attacks, and in the southeastern portions of the burn a considerable number of these snags had been windfelled. The ground was covered by a heavy grass-weed stand, of which pine grass, (Calamagrostis rubescens) was the principal component.

The bulk of the reproduction consisted of Douglas fir. It was very well represented in the above mentioned openings and, being more tolerant, was evidencing a tendency to capture the ground under even the heavier portions of the ponderosa pine overstory. Ponderosa pine saplings, however, were comparatively well represented in the southeastern portions of the area and one large patch of mixed ponderosa pine - lodgepole pine saplings, several acres in area, was found near the approximate center of NE¼ section 15. Also several groups of excellent ponderosa pine poles and saplings were found on the low saddle north of the butte and on the steeper slopes near the north end of the area.

The marked timber on the area comprising approximately 3,500,000 feet board measure of ponderosa pine was all felled during the summer of 1942 by loggers in the employ of Mr. Ray Wilson, who had purchased this timber from the Lincoln Lumber Company, the contractor on the West Fork Unit. The cut per acre averaged approximately 9,000 board feet, which is unusually heavy, as has been indicated, for the Colville Reservation. Because of the younger age classes, however, the quality was not above average. Common and box grades predominated to a greater extent than in lumber cut from older mature and overmature trees.

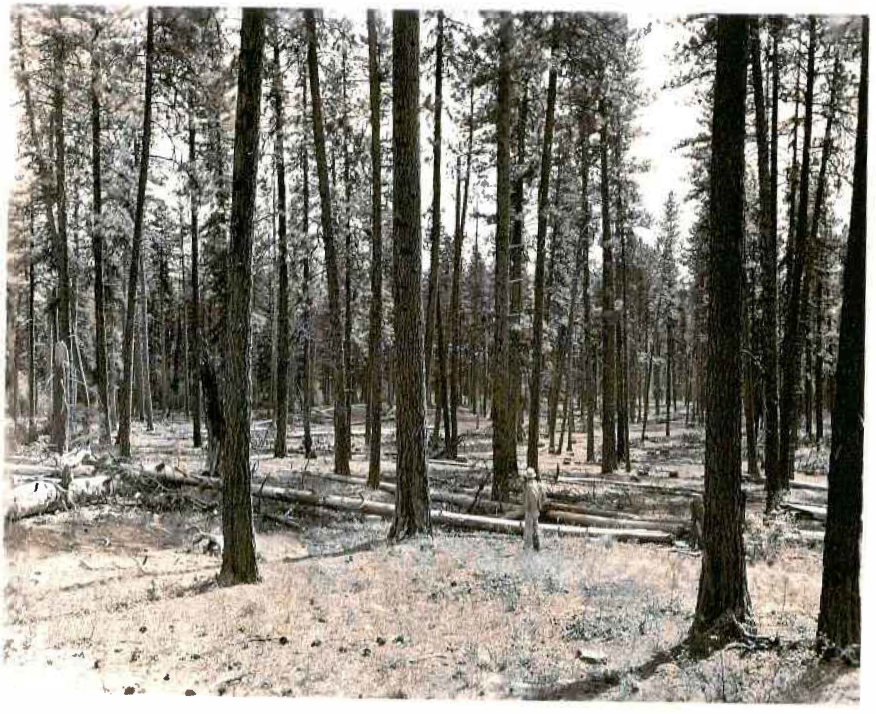
Unfortunately weather conditions became so severe during the fall of 1942 that Mr. Wilson was forced to leave approximately 2,000,000 feet board measure of his logs in the woods. Subsequently, during the winter, he dismantled the West Fork Sawmill, according to plan, and moved the machinery to Warm Springs, Oregon. When he left the Colville Reservation, therefore, there still remained 3,500,000 feet board measure of slash to be disposed of, together with the 2,000,000 feet of logs to be skidded and trucked.

Sometime during the spring of 1943, Mr. Wilson sold the remaining logs to the Harter Lumber Company of Spokane. Operations of this company were much

Photo No. I

Twentythree Mile Area

Reserve stand of ponderosa pine on selectively logged area in NE/4 SE/4 section 10, township 33 north, range 33 east, before broadcast slash burn. Ray Wilson removed the logs from this portion of the area during the fall of 1942. Stand, ground cover and slash conditions were typical of the area burned.



delayed, because of the late spring rains and difficulties encountered in obtaining the services of a sub-contractor for the skidding and trucking. Finally, late in July, Mr. Clarence Reed of Colville, Washington, established a camp one mile east of the area, on the north fork of Twentythree Mile Creek, and started logging operations. He operated a fleet of four trucks, hauling to the San Poil bay of the Columbia Reservoir. For skidding he employed an International "40" tractor with bulldozer and for loading he employed two jammers mounted on old trucks. Mr. Reed was a firm believer in the advantages of building many spur roads for the purpose of shortening skidding distances. These roads had an important influence on subsequent burning operations.

The Burning Operations

During the summer of 1943, when the possibilities of conducting broadcast slash burning operations were being discussed, Mr. Hall, by then in charge of the Twin Lakes Timber Sale, suggested trying the Twentythree Mile area, because very little ponderosa pine reproduction would be endangered, while the crowns of the overstory of reserved trees would be largely beyond reach of the flames. Also, he suggested, the ground conditions were such that the fire would be easily controlled. He warned, however, that the burning would have to be conducted early in the fall, for once the rains start at such high elevations in the northern San Poil district it is seldom that forest fuels again become dry enough to burn before winter snows fall. The proposed burning, it was agreed, would probably be of silvicultural benefit if it destroyed the Douglas fir reproduction.

Early in September, Mr. Francis S. Van Sickle, Forester, in charge of the West Fork Sale, discussed the proposed burning with Mr. Reed, who was anxious to cooperate, since it appeared that for the 2,000,000 feet of logs that he was under contract to move, the sum of 50 cents was being held back by Harter Lumber Company for each thousand board feet until such time as he disposed of the slash in a manner acceptable to the Indian Service. He also readily agreed to assist in the disposal of the slash on the various portions of the area from which Mr. Wilson had removed the logs. Accordingly, at the suggestion of Van Sickle, he employed his tractor, at odd times thereafter, in the bulldozing of a fire line along the entire east and north boundaries of the proposed burn. Along the south and west boundaries he was able to tie in partially with existing logging roads that served admirably as fire breaks. To insure better disposal some of his men were employed at "lopping" the branches from the tops. Only 20 per cent of the area was covered, however, before burning started. He was also supposed to fall the dangerous snags,but this important job was only partially conpleted,when the burning started.

By September 17th, rising humidity, increasing cloudiness, and a falling barometer together with the fire weather reports received in code each evening from the station of the Weather Bureau in Seattle, apparently indicated the approach of a rain storm. The writer, therefore, by long distance telephone, requested permission to burn of the State Forester and of the Army authorities, through the Regional Forester's Office in Spokane. Permission was granted and preparations were made to dispatch the remaining six men of the Agency fire crew to the area when conditions appeared favorable for burning.

Mr. Reed was also instructed to hold his crew in readiness to assist. Mr. Pete Whitelaw, Scaler, was instructed to take charge of the operations.

On Saturday, September 18th, conditions were still too dry and hazardous for burning. Mr. Whitelaw inspected the proposed operation and made suggestions to Mr. Reed with respect to additional snag falling. Also, a fire line was bulldozed about the patch of mixed ponderosa pine - lodgepole pine saplings in the middle of the NE¼ section 15, for the purpose of excluding this area from the burn.

Increasing cloudiness occured on Sunday and on Monday morning, September 20th, dark clouds completely filled the sky. Messrs. Whitelaw, Walter Moomaw, Scaler, and Van Sickle together with the fire crew, consisting by this time of four men, and the writer arrived on the area at 9:30 A. M. A very light rain was falling. Burning operations were started immediately in the south eastern portion of the area. Branches, tops and piles of logging debris burned readily, though the fire evidenced no inclination at that time to run through the grass or reproduction. It was therefore necessary to fire each top or debris pile. Windfalls and old rotten logs continued to burn, however, and fires spreading from these, on subsequent drier days, crept through the dry grass until approximately 100 per cent of the area was burned.

The fire guard crew, it should be mentioned, used propane gas torches for starting the fires. Tanks of "Shellane" from the Agency supply were used for refilling. Mr. Reeds crew, consisting of four men, used torches of oily rags bound on long sticks.

Light rains continued intermittently until almost noon, by which time approximately 50 acres had been burned. After noon the rain ceased entirely and the fire,by its action, indicated lowering humidity. It began running through the grass and it was no longer necessary to fire every top. Late in the afternoon when the east slope of the low butte was burned, the slash burned fiercely and in one small area where it was permitted to run uphill, the fire caused rather serious scorching to the reserve stand. It is interesting, when considering the manner in which the fire behaved during the day, to consult the Colville Agency weather record on page 8. It will be noted that the relative humidity was 65% at 8 A. M., 35 % at 12 N, and 18 % at 4:30 P. M., while for the same hours the fuel moisture dropped from 8.4 % to 7.2 % to 5.8 %. No rain fell at the agency, though, as has been indicated a very light rain fell at the fire. Undoubtedly the humidity and fuel moisture were at all times higher at the fire, but the trend in changes therein undoubtedly followed the same pattern.

The area was so broken up with spur logging roads and skid trails that scarcely any difficulty was encountered in controlling the fire. The burning resolved itself into the firing of many small blocks of slash of such sizes and intricate shapes that a detailed account of the operations would be impossible. A block of 10 to 20 acres between main logging road spurs would be selected for burning and 6 to 8 men would be lined up at approximate

50 foot intervals. Pete Whitelaw would then go from man to man, as they proceeded through the woods, directing and assisting with the burning. On arrival at the designated spur, bounding the block to be burned, the men would again be lined up for the burning of a return strip. It is probable that 100 acres were burned on the 20th.

The 21st dawned clear and it was obvious from the rising barometer that the threatened rain storm had failed to materialize. It was therefore decided to complete the burning of the area with the greatest speed possible. Reed's logging crew started the burning early in the morning and had a considerable area completed by the time that the Agency fire crew arrived. It was then decided to backfire the east and north lines, bounding the un-cut timber. Considerable difficulty was experienced from spotfires along the east line, because of standing larch snags that Reed's loggers had failed to fall. These snags were festooned with dry lichens that ignited readily from sparks from the ground fire. Then the fire would climb speedily to the very tip of the snag and a regular blizzard of live sparks would shower across the fire line, starting innumerable spot fires in the dry grass. These were too numerous for the patrolmen at one place and it was necessary for the tractor to bulldoze another line. Burning ceased at noon because of the increasing hazard.

Late that afternoon and evening and early on the morning of the 23rd the fire line along the north side was backfired and the entire northern part of the area was burned. It was found, incidently, that because of the outcrops of solid granite rock it had been impossible for Reed to include all of the slash in NE¼ section 10 within the fire line. Slash from approximately 150 to 200 M feet B. M. from scattered trees cut at higher elevations on the slope still remains unburned. This, as indicated, is so scattered and of so little importance that the operator has been excused from further efforts to dispose of it.

During the 22nd all of the slash remaining on the southern portion of the area was also burned, except that remaining on approximately 48 acres, from which Reed still had 250 to 300 feet B. M. of logs to remove. After these logs were removed there was no further opportunity to burn during the fall of 1943.

An incident worthy of note was the firing of the patch of reproduction about which the fire line had been built, by an old logger, who thought that it had been "missed". This mistake developed into no "catastrophe", however, for most of the ponderosa pine saplings still have green tops and stand an excellent chance of survival.

Activity subsequent to September 22nd consisted solely in the felling of the remaining standing snags, with respect to which Pete Whitelaw was insistent, and in routine patrol by Reed's crew.

Photo No. II

Twentythree Mile Area

Forest Guard Mathew Dick using propane gas backfiring torch to set backfire near fire line in SE/4 NE/4 section 10, township 33 north, range 33 east, September 21, 1943. For fire suppression purposes, as well as for slash burning, the forestry staff of Colville Reservation considers this torch the most effective. Since torch will burn only 3 to 6 hours, filling in the woods presents the principal disadvantage. This was overcome by filling from Shellane tanks transported to the fire line in "pick-up" trucks.

Photo No. III

Twentythree Mile Area

Slash fire burning in NE/4 SE/4 section 10, township 33 north, range 33 east, late afternoon of September 21, 1943. Near the center of the picture can be seen Scaler Walter Moomaw setting fire to dry pine snag by means of propane torch.

C O S T S

Mr. Reed, unfortunately, has thus far failed to provide us with a statement of the costs incurred by his outfit in connection with the burning, though requested to by letter on the date of November 24, 1943. The following are the costs incurred by the Indian Service Forestry Division on the burning.

Salaries & Wages of Regular Forestry Personnel and Fire Guards	$ 202.47
Car Expense 932 miles @ 5¢ per mile	46.60
2 Tanks of Shellane @ $13.39 per tank	26.78
TOTAL.....	$ 275.85

RESULTS AND CONCLUSIONS

It is obvious that the burning operation was highly successful in disposing of the logging slash and of the other heavy forest fuels in dead snags and windfalls. In fact, as a fire hazard reduction project, it was much more effective than would be the pile and burn operations depended on in the past for the disposal of such logging slash, for the fire covered a much greater percentage of the ground surface, and, as indicated, consumed much of the other forest debris and litter not normally ignited. Damage to the reserve stand by scorching of needles and basal burning, however, was more severe than would usually result from piling and burning, as was to be expected. Few if any of the trees will die, however. Damage to advance reproduction was also heavier though at this early date it appears a certainty that the majority of the ponderosa pine saplings and poles will survive. Damage to seedlings, saplings and poles of Douglas fir and lodgepole pine was severe, as was also expected. This, it is believed, will be of silvicultural benefit, since development of ponderosa pine seedlings appears to be favored by the action of fire.

It was found that on the lopped area the fire did a more thorough job of cleaning up the branches of the dry tops.

It is obvious that the burning operation could have been improved had there been sufficient supervisory personnel and man-power to have burned the entire area during the first day, when weather conditions for such operations were more favorable. Also, all of the dangerous snags should have been felled. It was apparent that Reed, though anxious to cooperate, also had his mind on production and delayed snag felling until the last minute. Thorough preparation of fire lines and the felling of all dangerous snags, both inside and outside of the fire lines should be mandatory prerequisites to future slash burning operations of this nature.

KARTAR SLASH BURN

Location & Area

The map of this area, attached hereto, indicates that the slash burn covered approximately 720 acres, in blocks number 1, 2 and 3, in sections 16, 17, 20 and 21, township 32 north, range 29 east, W. M., in the Kartar Timber Unit. As is also indicated by the map, it was originally planned to burn an additional 1000 acres in section 8, in the Moses Mt. Unit and in sections 8, 17, 18, 19, 20 and 21 in the Kartar Unit, in the same township and range. This was prevented, however, by generally adverse weather conditions and by the lack of sufficient man-power and supervisory personnel to enable takihg full advantage of the short periods of favorable burning weather that did occur.

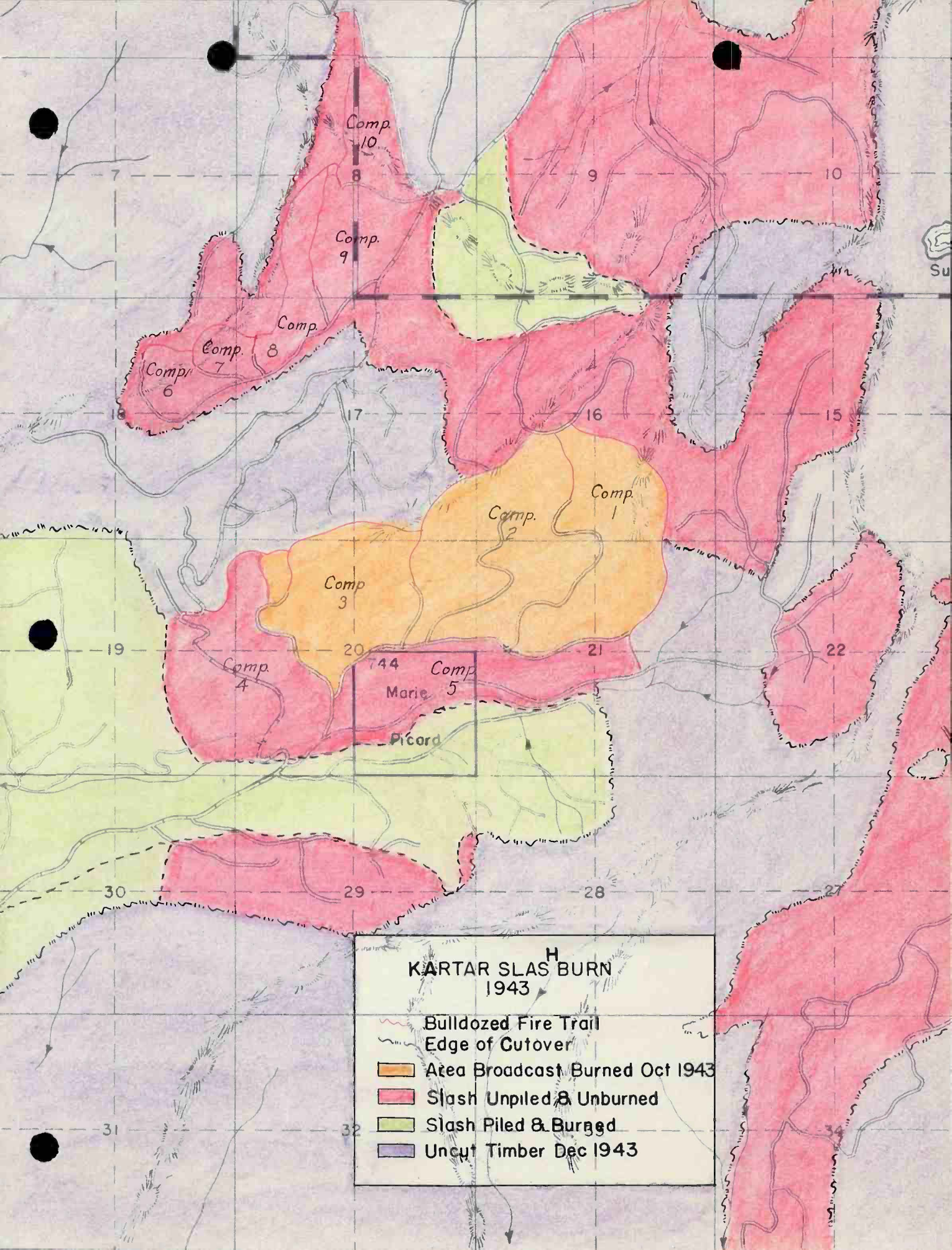
Topographic & Geologic Features

An accurate topographic map of this area is unfortunately not available, though township 32 north, range 29 east, was included in the forest survey conducted under the CCC program during the years of 1940 and 1941. The local CCC organization at that time was declining rapidly with respect to enrollment and skilled supervisory personnel. The field notes therefore, have never been fully computed, and the services of a skilled draftsman, needed for the compilation of an accurate base map, have since been unavailable.

The roads and logging spurs indicated on the map of the area, however, have been accurately traversed and tied in at section line crossings by members of the forestry personnel. Also, the streams, intermittent streams and ridge tops were copied from aerial photographs and are believed to be reasonably accurate. Information with respect to elevations, however, must be based purely on estimates.

The burn lies on moderate to steep slopes along the south side of a subsidiary ridge, which, as the map indicates, extends in a southwesterly direction from the main Omak ridge. The burn is bounded, as the map also indicates, and is divided into three separate compartments, numbered 1, 2 and 3, by fire lines that were bulldozed along the top of the main ridge and down southward extending spurs, and by old logging road spurs. South of the burn lies a long, narrow area of unpiled and unburned slash, identified as compartment 5 on the map. The main logging road comprising the south boundary of this compartment roughly parallels Kartar Creek. The area south of the creek has also been selectively cut, but most of the slash has been disposed of by piling and burning. West of the burn lies another area of unpiled and unburned slash, identified as compartment number 4. On the east, at the time of the burn, the timber was still uncut.

North of the burn the features of significance are the broad basin, almost plateau like in character, that includes, practically all of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KARTAR SLAS BURN
1943
Bulldozed Fire Trail
Edge of Cutover
Area Broadcast Burned Oct 1943
Slash Unpiled & Unburned
Slash Piled & Burned
Uncut Timber Dec 1943

section 17 and portions of sections 8, 16, 18 and 20, the northwestward trending main Omak ridge, bounding the basin on the north, and the high southwestward trending ridge bounding the basin on the west. This heavily timbered area has been largely selectively cut and with the exception of the area of approximately 200 acres designated as "piled and burned", all of the slash is still unpiled and unburned. On the high ridge to the west, however, fire lines were bulldozed and the slash was piled on a narrow strip along the logging spurs. It was planned to broadcast burn this ridge, after completing the burning of compartments 4 and 5. As has been indicated, however, adverse weather prevented this. The large area of heavy slash in the basin and on Omak Ridge should also be broken up by blocks or strips of broadcast burned slash. During the fall of 1943 most of this slash was still too green for such burning, because the area had only recently been logged.

During the Pliestocene epoch the entire Omak Ridge and other adjacent mountains with the exception of the very top of Moses Mountain, were over-ridden and ground down by the tremendous Okanogan glacier. The topography, therefore, is characteristic of heavily glaciated regions. With the exception of the rounded solid granite outcrops, occuring along the tops of the ridges and spurs, the entire area appears to be underlaid by glacial drift of varying depth. Large, rounded granite boulders are numerous. Of interest, also, are a number of large basalt boulders, on Omak Ridge, that were obviously transported by the ice from some distant point. The soil is a sandy loam, evidently of decomposed granite.

The Forest

The forest on the area burned is typical of the ponderosa pine region for it is characterized by the existence of uneven-aged stands made up of even-aged groups in various stages of maturity. It was therefore possible for the timber marker to leave an excellent reserve stand of age class 1 and 2 trees and class 3 trees with A crowns. With respect to younger age classes numerous groups of thrifty, fast growing poles occur in compartment number 1 and on the lower slopes in compartments 2 and 3. All of these pole groups survived the Omak Ridge Fire of 1920, the last of numerous wild fires that used to sweep this area.

On the burned area, as well as on unburned compartments 4 and 5, it is noted that numerous one year old seedlings, originating from the 1942 seed crop, are growing on most of the abandoned truck roads and skid tracks. These seedlings occur singly and in groups of 6 to 12 or more where planted by the chipmonks. Aside from the one year old seedlings the age groups of sapling and seedling size are not well represented except on compartment number 5, which, in addition, has numerous groups of fast growing poles. To burn this compartment under present conditions, it was decided, would cause excessive damage to the excellent seedling stand. Possibly in another 10 or 15 years, after the reproduction develops to such size that it can better resist fire, it may be possible to reduce the hazard by controlled burning.

Before cutting the stand volume of ponderosa pine averaged approximately 9000 board feet per acre, with volumes heavier than the average occur-

ing in compartment 1 and in the southern portions of compartments 2 and 3 and with very light volumes occuring on the more open slopes in the steeper, northern portions of these compartments. Approximately 70 per cent of this volume, 6,300 feet board measure per acre, was removed by the logging operation conducted by Cotter, a sub-contractor of the Biles - Coleman Lumber Co., during the summer and fall of 1942.

With respect to past pine beetle losses, annual cruises conducted by the crews operating from the Forest Insect Laboratory of the Bureau of Entomology and Plant Quarantine, Portland, Oregon, indicate that during the eight year period, 1934 to 1941, inclusive, approximately 4.53% of the total merchantable stand volume was lost on the closely adjacent W½ Section 20, township 32 north, range 29 east. The average loss per acre per year amounted to 57 board feet. Cruises were discontinued in 1942 because of disturbance to the check plot by Cotter's logging operations. It should also be noted that the cruises do not include the previous years, approximately 1929 to 1932 inclusive, when the beetles were severely epidemic and when considerably higher losses were sustained. It is probable that since 1920, the year of the last fire, at least 15 per cent of the mature stand has been killed by the beetles. Growth has probably off-set this loss.

Attacks of the western pine beetle, resulting in holes being made in the over-story, account for the presence of even-aged groups of trees in various stages of maturity. The frequent surface fires gradually consumed the dead snags and windfalls resulting from the beetle attacks, and thinned the patches of ponderosa pine reproduction that developed in the openings thus caused. Thus the virgin ponderosa pine stand, as we have found it, has been profoundly influenced with respect to density and age classes by the action of the fire and beetles.

Conditions on the above mentioned W½ section 20 are also typical of the closely adjacent burned area described herein. Judging from the numerous snags and windfalls compartment 1 suffered the most severe beetle losses during the years subsequent to the 1920 burn. Also, as has been mentioned, it supported the heaviest mature stand before logging.

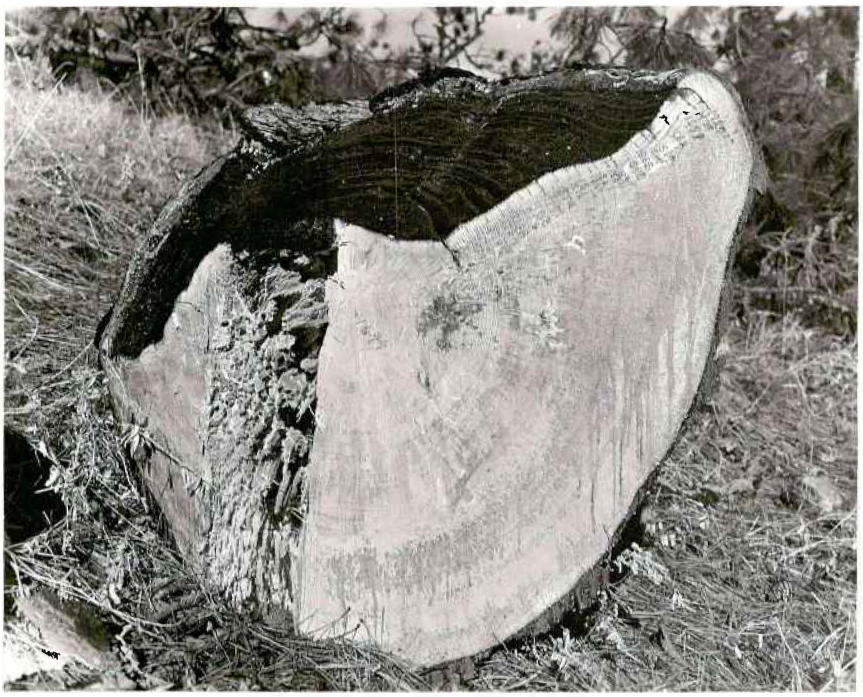
With further reference to the mature stand it should be mentioned that occasional Douglas fir and western larch trees are scattered through the forest in the more sheltered situations. Reproduction of these species, however, was exceedingly scarce. North of the burn, in the previously mentioned basin and on Omak Ridge, Douglas fir and western larch comprise a higher percentage of the mature stand and the reproduction, in places, is exclusively of these species.

The ground cover on the burned area and on the adjacent areas consists principally of a dense grass and weed stand of which pinegrass and beardless wheatgrass (Agropyron inermi) are the principal components.

Photo No. IV

Kartar Area

Butt cut of 300 year old ponderosa pine felled in late October, 1943, by Biles Coleman Lumber Co. men outside of slash burn in SE/4 SE/4 section 16, township 32 north, range 29 east, W. M. The healing seams on fire scar indicate that at least 24 different forest fires burned during the 181 year period from 1739 to the year of the last fire, 1920. The approximate average interval between fires was 7 or 8 years. Due to forest protection 23 years without fire have elapsed since 1920.



The Burning Operation

Details with respect to the proposed burning operation were planned in company with Mr. Emmett Aston, Woods Superintendent of the Biles Coleman Lumber Company in late September, subsequent to the slash burning operation at Twentythree Mile Creek. It was agreed by Aston that the Biles Coleman Company would assume responsibility for the payment of salaries of several of the temporary Indian Service fire guards during the period of the burning. The men were to be paid at the rate of 80 cents per hour, in accordance with the schedule of rates for fire fighters east of the Cascade Mountains for the year of 1943. One foreman was to be paid at the rate of 90 cents per hour. It was also agreed that Pete Whitelaw would have supervision of the burning operation.

One heavy caterpillar tractor with bulldozer, normally used by the Biles Coleman Company for the construction of logging truck roads, was used for fire line construction and for the pulling over or pushing over the snags near the fire line. The company's motor patrol was used to clear the dry grass, needles and other debris from the abandoned logging spurs to be used for fire lines.

On the date of October 4th, humidity, fuel moisture and barometric pressure readings at Colville Agency again apparently hearlded the approach of a rain storm. The men instructed to receive the code weather message during the evening, however, forgot this important assignment and we were deprived of information that undoubtedly would have changed our plans.

October 5th dawned with a light rain falling at Colville Agency, as is indicated for that date in table No. II. As the crew proceeded to the north end of compartment 1, by way of the Omak highway and the Omak Ridge summit, however, it became apparent that not a drop of rain had fallen in the Kartar district. Furthermore, a cold gusty north wind started blowing. Along the fire trail the dust, in many places, was almost knee deep. To test the burning possibilities a small body of slash entirely segregated by skid trails was first fired. This convinced us that it would be wise to postpone further burning until near nightfall.

It was found that the Biles Coleman tractor, then engaged in pulling over snags along the south line of the proposed burn, had not yet worked along the north fire line of compartment 1. The Agency fire crew was therefore organized into two snag felling crews that accounted for approximately 40 dangerous snags before the tractor cought up with them late in the afternoon.

By that time heavy dark clouds had formed, though the north wind continued to blow fitfully, and a few rain drops fell. At 5 P.M. the Agency crew, each man equipped with a propane gas backfiring torch, started the backfiring of the north line of the compartment. By 6 P.M., when we were joined by Aston, together with four of his employees, the line along the north end and the high spur comprising the northeast corner had been successfully back fired and the fire was advancing slowly down hill on a crescent shaped front. The men worked slowly back and forth across the face of this crescent, setting strip fires in a manner judged best to prevent any appreciable "runs" uphill.

Conditions at first seemed very favorable. As the night advanced, however, the north wind increased in intensity and the stars came out. In the shallow draws freak air currents caused the fire to "lash about" in an unpredictable manner. It became apparent that we were involved with a slash fire that was considerably more dangerous than the one experienced at Twenty-three Mile Creek. Conditions were much drier, due to the lower elevation, and, despite the lighter cut and supposedly lighter slash accumulation, there appeared to be more inflammable material on the ground. This probably can be partially accounted for by the fact that mature and over mature trees with full crowns and big limbs were here cut, while at Twentythree Mile, because of the younger age classes cut and the smaller crowns due to the crowding in of the heavier stand, the slash accumulation was actually lighter, despite the heavier cut per acre. Also, the ground was conparatively level at Twentythree Mile.

Many of the big trees had been felled into the patches of poles and it was in such places that the fiercest fires and greatest damage developed. When the fire reached the big dry limbs and tops in such places the freak air currents often caused it to burst through the tops of the poles in any conceivable direction and to send off a regular procession of whirlwinds carrying fire and burning embers.

It also became apparent, with the addition of the Biles Coleman men, that too many men were engaged in setting fires and that some of them had a tendency to set fire to swaths of material that were far too wide. They were therefore ordered to patrol the fire lines, while for the duration of the night Pete Whitelaw, Scaler Walter Moomaw and Mathew Dick, one of our fire guards, attended to the setting of the fires.

At one point on the west side where there was a large amount of slash and cull logs from a number of big trees, it was necessary for Aston to hold his crew for a considerable period of time because of the whirlwinds that threw burning material over the fire line.

Had compartment 1 been broken into smaller blocks by means of subsidiary fire lines we would gladly have stopped the burning early in the night. Lacking such lines, however, it was necessary to continue until all of the 230 acres in the compartment were burned. This was finally completed at 7 A.M. on the morning of October 6th.

Until almost daylight the north wind continued to blow and the fire burned with unabated intensity. Several large western larch trees that crowned and "blew up" provided scenes of momentary beauty that were hardly appreciated at the time. Such trees readily "crown" because of their low branching habits and the abundance of dry lichens festooning the limbs and main trunk. Also, the needles had turned golden in color from severe frost occurring in late September and were rather easily detached. The fire, roaring up through the tops blew many thousands of the burning needles into the air where, in the rolling smoke clouds, they appeared as incandescent sparks. For many minutes after

the blow up the glowing needles remaining on the branches gave each tree a glittering, incandescent, "Christmas tree" appearance.

Finally the fire lines cooled sufficiently and the fired fire crews started for home at 7:30 in the morning. Aston, at that time, discussed the possibility of conducting a salvage cutting of the supposedly numerous fire killed trees in the reserve stand. During the day Edward Whalen, Senior Forest Ranger, and Edward Hall, who had arrived from the Twin Lakes Sale to assist with the burning, made an examination of the burn and inspected the activities of the patrolmen provided by Biles Coleman.

Daylight disclosed that the damage was not nearly as severe as had been anticipated during the previous night. Very few of the reserved merchantable ponderosa pine trees had been crowned. Several fine patches of poles had been entirely destroyed, but the majority of the pole groups suffered only moderate to light scorching, and many of the poles in the more severely scorched groups appeared to have an excellent chance of survival. It was estimated that only 15 to 20 per cent of the poles had been killed. With respect to the sapling groups, it was estimated that 50 per cent of the trees had been killed. Those who had worked on the fire during the night were surprised that any of the poles or saplings had survived.

The fire, obviously, had been too hot. It served well to illustrate, however, that the ponderosa pine tree is exceedingly resistant to fire and can survive fires that would most certainly destroy such associate species as Douglas fir and white fir. It was a surprise to find that most of the year old seedlings along the skid trails had apparently survived, probably because of the lack of sufficient dry needles to carry the fire and because they were near enough to the ground to escape the sweep of the flames from nearby slash. It was a surprise, also, to learn that in the confusion of the previous night a number of islands escaped burning because of the protection provided by surrounding skid trails. Where it appeared that minimum damage would result a number of these islands were subsequently burned.

Because of the experiences herein discribed it was decided to discontinue burning, aside from the burning of the islands, until more favorable weather conditions became a certainty.

On October 9th, conditions again appeared favorable for burning and this time a weather report from Seattle verified the fact that a rain storm actually was on its way. Under Pete Whitelaw's supervision the fire crew was again assembled, this time along the north fire line of compartment 2. Gusty winds, however, caused them to delay firing until 5 P.M.

Though compartment 2, containing 285 acres, was considerably larger than the previously burned number 1, the slash volume was lighter and fewer patches of reproduction were encountered. This fact, together with better organization resulting from experience gained on the previous fire, enabled the burning to proceed at a much more rapid pace, despite one hour of delay resulting from the necessity of employing the entire crew in the extricating of a govern-

ment pick-up from one of the bulldozed fire trails, down which one of the guards attempted to drive it in disobedience of Pete Whitelaw's orders.

Burning of the upper half of the compartment was completed when rain started falling at 8 P.M. It then became necessary to set fire to every dry top or pile of debris and as the night advanced it became a struggle to make the fire burn. Finally Burning was abandoned at 2:30 A.M. the morning of October 10th.

Subsequent examination disclosed that while the fire on the upper half of the compartment approached that on compartment 1 in intensity, there still remained a number of unburned islands where protected by skid roads. Most of these were subsequently burned. Where the burning proceeded over the southwestern portion of the compartment, after the rain started, the burned patches became progressively smaller. Finally, in the south east corner, there still remains a sizeable area where it was impossible to fire the slash. For the entire compartment it is estimated that 75 per cent of the slash has been disposed of. Damage to reserved trees, poles and saplings was considerably lighter than on the previous burn and was confined almost entirely to the northern part.

Clearing weather returned on the afternoon of October 11th and by the afternoon of the 13th it was again dry enough to attempt burning. Accordingly Pete Whitelaw again assembled his fire crew and started burning operations at the north end of compartment 3 at 9 A.M. on October 14th. Conditions were ideal and by 6 P.M. the crew of four men completed the burning of the 200 acres of the compartment. Because of the lack of sufficient men to properly patrol, the fire did escape over the line to burn an undetermined area of the extreme northeastern portion of compartment 4. No damage resulted, however, and the spot fire was speedily controlled.

Subsequent examination disclosed that this burn was indeed the most ideal, for while it disposed of better than 90 per cent of the slash it covered but the minimum of damage to the groups of poles and saplings. It is apparent that the greatest majority of the trees in these younger age groups will most certainly survive. The only "eye sore" developed at the extreme south end where the fire guard who had disregarded Pete Whitelaw's instructions with respect to driving the pick-up down the fire line on the night of October 10th, again disobeyed him by setting fire on the wind-ward side to a patch of heavy slash in a sapling and pole stand.

On the morning of October 15th a heavy rain storm put an end to further broadcast slash burning operations for the fall. Early in November, following a series of sunny days, an attempt was again made, but was speedily given up when it was observed that less than 50 per cent of the slash could be induced to burn.

Photo No. V

Kartar Area

Late October, 1943, view to west across compartments 1 and 2, subsequent to the slash burn. Compartment 3 lies behind the heavily timbered ridge in middle distance, though south end includes part of timber in view on flat in distance behind fading, light appearing, western larch tree at left. Scorched foliage of ponderosa pine hard to detect, though some is visible in right middle distance, to left of another fading western larch. In immediate foreground is small, unburned island, protected by skid trails. Sapling and pole patch in center of picture was burned and partially scorched. Snow covered Cascade Mountains in distance.

COSTS

The following is a summary of the costs incurred by the Biles Coleman Lumber Company in the burning of 4,500,000 feet board measure of logging slash in the combined area of 720 acres of compartments 1, 2, and 3.

Wages - Fire fighters & patrolmen (Biles Coleman employees)	$ 68.00
Car Expenses - 48 miles for pick-up truck @ 10¢ per	4.80
Tractor Expense at snag falling 12 hr. @ $7.00 per (includes wages of driver & one helper)	84.00
Tractor Expense at fire line construction (includes wages of driver and one helper) 8 hr. @ $ 7.00 per	56.00
Supplies - 3 Tanks Shellane @ 13.39 per	40.17
6 gals. Kerosene @ .25	1.50
Wages of Fire Guards loaned by Indian Service	130.30
TOTAL COSTS	$ 384.77
Average costs per M feet of slash burned	0.085
Average Cost per acre of slash burned	0.534

The following is a summary of the expenses incurred by the Indian Service.

Salaries of Regular Forestry Employees	$ 84.49
Car Expenses 700 miles @ 5¢ per	35.00
	$119.49
Total Expenses (Biles Coleman & Indian Service)	504.26
Average costs per M feet of slash	0.112
Average costs per acre of slash burned	0.700

Results & Conclusions

It is obvious that the Kartar slash burn caused more damage to the reserve stand and advance reproduction than would have been caused by well supervised pile and burn operations, but as a fire hazard reduction measure it is highly successful and this, it is believed, in view of the critical slash situation on the Kartar and adjacent Moses Mt. sale areas, fully justifies the action taken. The damage in fact, falls far short of devastation, for, as has been explained with respect to the ponderosa pine stand, but few of the reserved trees have been too severely scorched and most of the poles will survive. The principal adverse result is the loss of several years of growth, during the period required for the more severly scorched reserved trees and poles to develop new crowns and to recover from severe cambium scorching, and through the loss of many trees of the seedling class. Possible silvicultural benefit through the thinning of over-stocked reproduction stands can hardly be considered, since such conditions of over-stocking existed before the fire in but a few sapling groups of several acres in total area.

Mr. F. P. Keen, Senior Entomologist, Bureau of Entomology and Plant Quarantine, in charge of forest insect investigations on the Pacific Coast, who inspected the burned area on October 15th in company with Mr. James Evenden, Senior Entomologist, in charge of the Coeur d'Alene Forest Insect Laboratory of the Bureau, and the writer, is in substantial agreement with the conclusions and opinions above presented. It was his opinion, in fact, that within five years it will be difficult from superficial observation to tell that the fire herein described has burned. Mr. Keen recommended, incidently, that compartment 5 be left unburned.

When giving consideration to areas where future broadcast burning operations may be necessary it is appropriate that the various advantages and disadvantages of the method be summarized for consideration. It must be confessed, in this connection, that it is easier to list the disadvantages. The following, however, are some of the possible advantages and disadvantages that occur to the writer.

Advantages of Broadcast Burning

1. Under favorable weather and slash conditions it reduces the fire hazard to a greater extent than would piling & burning, for the snags, cull logs and other inflammable debris are also largely consumed.

2. It may prove of silvicultural benefit through the killing of advance reproduction of less fire resistant inferior species that are associated with ponderosa pine and that have a tendenty, in the total absence of fire over a long period, to capture too great a percentage of the ground surface.

3. It may prove of silvicultural benefit through the thinning of over-stocked patches of advance reproduction of ponderosa pine. It must be remembered, however, that logging slash fires are usually terrifically hot in comparison to fires that burned under natural conditions and the thinning,

therefore, may prove excessive, in spite of the greatest care.

4. It may prove of silvicultural benefit through the removal of dense litter and duff, or grass & weeds, in such manner that the development of ponderosa pine reproduction may subsequently be encouraged.

5. It may prove of benefit to wild life and to grazing animals. For instance various browse shrubs, that eventually grow to such height that the leaves and tender twigs are beyond the reach of the animals, are killed back and caused to sprout luxuriently from the root collar. It is noticed that deer and cattle apparently prefer the burns, possibly because of certain mineral salts obtained from the ashes, ease of dusting to discourage insects, the above discussed advantage in browsing, etc.

6. The method is considerably cheaper than the pile and burn method and for this reason appeals to the operators.

Disadvantages of Broadcast Burning

1. The method is dangerous, even when the greatest care is exercised, for a sudden shift in wind or change in humidity and fuel moisture may cause the fire to become uncontrolable. During the present period of man-power shortage this disadvantage is of particular significance.

2. Periods of favorable burning weather are sometimes rare. Witness the past fall when, as has been explained, only one or two days of weather favorable for such operations occured during the entire fall.

3. Greater care must be taken in applying the method, as has been indicated, and the worry caused to the responsible forest officer is considerable.

4. Even with the greatest care the method may cause excessive damage to advance reproduction and to the reserve stand. This makes its use inadvisable where ever extensive seedling stands are becoming established.

5. Insects, such as the western pine bettle may be encouraged to attack considerable numbers of the fire damaged trees.

6. Damage may be caused to the range.

From the experiences and results herein described the writer and his associates have concluded beyond any doubt that they much prefer to burn slash that has been properly piled during periods of favorable weather conditions. Unfortunately, however, piling seems almost an impossibility under present conditions and we must therefore become better acquainted with broadcast burning.

In the future it is believed that adequate fire lines should be built about every 40 to 80 acre tract, instead of 200 to 300 acre tracts. If possible the snags should be felled by snag felling crews, or by power saws, instead of by tractors. The Biles Coleman tractor, it was observed, was so huge that it mowed down whole patches of reproduction. Usually the snags are standing in the midst of such patches. The tractors can be employed in shoving heavy inflammable debris away from the fire line, where necessary. Tops should be lopped, as previously recommended.

During the actual burning the fire, after the uphill line is backfired and made safe, should be permitted to burn downhill or against the wind at the natural pace that it assumes under existing conditions of fuel and humidity, except where it is necessary to help it across skid roads or logging spurs. During the past fall strip burning was resorted to because it was necessary, with the small crew available, to burn out the entire area inside the fire line in the shortest possible period of time. If sufficient men and fire fighting equipment are available several small blocks can be burned simultaniously. Where advisable, reproduction patches should be excluded from the burning by adequate fire lines.

The Biles Coleman Company intends to experiment with a small tractor in the piling of slash. The tractor has been purchased for this purpose by the company, but thus far its use, also, has of necessity been diverted largely to production. In fact, to our knowledge, it has spent only one day at slash piling and, because of other previous commitments it was impossible for any of our forest officers to be present.

If the tractor is skillfully handled it appears that its use will be of great benefit in slash disposal. By means of chokers it can skid the big tops out of the reproduction patches into the openings. There several of the tops, together with such other branches and debris that the tractor can gather up with a special "bush buck" installed in place of the bulldozer can be shoved together in a compact mass that can be disposed of by burning during rainy periods. Afterwards if deemed advisable, the remaining scattered slash and other debris can be disposed of by broadcast burning when conditions are advantageous. With such a method damage to the reserved trees and reproduction stands would be greatly reduced, for as was explained with respect to the burning of compartment 1, most of the damage was caused by the burning of the big tops.

It appears that such a method can be used only where the slash is still green, however, for in the older slash the rough handling by the tractor will cause most of the needles and twigs to shatter and fall to the ground. Its use, therefore, will probably be impossible in most of the older extensive slash areas herein discussed and described.

Every effort will be made to induce the Biles Coleman Company to make serious effortsto pile slash, with the tractor and by hand, if it is at all possible to hire men or boys for such work. Pressure in this respect will also be exerted on other operators on the reservation.

In the mean time experiments in broadcast slash burning will be continued. Admittedly it is an extremely dangerous method, but the slash situation on this reservation is such that it may be termed "desperate" and desperate measures to reduce the hazard are fully justified.